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FOREST SERVICE

Tropical Forest Experiment Station

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ANNUAL REPORT AND PROGRAM

Calendar Year 1944

The close of 1944 saw a clearer understanding of the forestry and forest land use problem in Puerto Rico. Measurable progress was made during the year in research to meet some of the forest management problems. A commencement was made in utilization studies. A realization of the need for research in forest resources (or economics) investigations took form. Here and there improvement is discernible in the basic economic and social conditions in Puerto Rico from which all forest problems stem and to which forest land management and utilization, and consequently forest research, must be geared.

The Island still has too many people, too little land, too limited a diversification in agriculture, too few industries, too much land abuse and idleness, too few highly productive forests; all resulting in too little employment for all of the people.

Neither the Insular or Federal Governments are doing anything about the first except some speculative conversation on the possibilities of emigration, and nothing can be done about the second condition. Puerto Rico's present agricultural economy is based principally on sugar cane, with coffee, tobacco, and food crops quite secondary. The administration is now planning an agricultural development program which with the present enterprises such as the Land Authority project and others should bring about greater diversification in agriculture. In this coffee must be included if that industry is to survive, and proper coffee culture is good forestry and watershed management.

The Puerto Rico Development Co., an Insularly financed industries stimulator, is vigorously pushing industrialization. Accomplishments to date comprise a cement plant, glass bottle factory, ceramics manufactory, wallboard plant (under construction), handicraft production throughout the Island, and other labor employing commercial enterprises. In the program stage are still others, the most important of which to forestry is the rejuvenation and expansion of the woodworking industry utilizing local forest products so far as they will go but based primarily on imported logs and lumber. Then too the P. R. Planning Board has completed a 6-year

program involving more than $100,000,000 of public works and services.

The foregoing programs will, as each becomes effective, provide more and more steady work for the half million people on the Island who are not now employed steadily enough, if at all, to be able to live above the lowest possible level. But all of this will not be enough to meet the unemployment situation unless and until land abuse is corrected (and this includes practices of some of the present Insular and Federal agencies); land idleness is eliminated; the present public forests, through good management and artificial regeneration, reach a productive sustained - yield basis including sawtimber growing; all lands fit only for forest production but uneconomic for private ownership are brought under public control; woodlots and the scattered larger timber ownerships are properly managed by their owners; and permanent forest communities are established. Forestry will play a vital role in remedying the basic problems and social ills of Puerto Rico if they are to be corrected to the maximum attainable extent.

Be that as it may, food and shelter meanwhile must be provided to several hundred thousand people in Puerto Rico. If there is no work, hence no cash income, the people must draw on the products of nature to live. This means shacks of round poles and palm boards and sheaths for walls and roofs, built without a cent of expenditure. It means tilling and raising the family's food on soils and slopes that should not be used for agriculture by all precepts of good land use. No amount of persuasion, technical justification, or legislation can change this situation so long as people are hungry and if the land managers are also humanitarians they will not take away this means of keeping a half million people from starving; that is, unless and until a substitute type of land use is devised that will give employment and some purchasing power to those same people. Only whenever and wherever that can be done for submarginal agricultural land can forestry do its share to improve the present basic conditions and remedy the present ills. But if research cannot find a way to make forest growing on non-agricultural lands and its attending attributes return as much in employment and daily comfort as practicing temporary agriculture on non-agricultural lands then in Puerto Rico those lands must stay in food raising regardless of the other consequences. With that situation prevailing, the immediate job for forest research is to investigate the problems related to and devise methods of the regeneration, management and utilization of products of those forest soils which clearly have no farming possibilities even for a few years' duration and of those lands which are not now occupied by farmers eking out the lowest kind of existence. In this program research must, nevertheless, be awake to and be prepared to deal with the problems of regeneration of and placing under good management those submarginal lands now farmed just as fast as the basic problems of the Island are remedied and more and more of the forest soils can be used for forest growing without people going without food.

The Tropical Station has been authorized and financed so far to conduct only forest management research. For the first 5 years, this was logical, nevertheless the Station, for the reason already stated, cannot go on and on dodging investigations into the economics of forest growing vs food raising acre for acre, defining where temporary cultivation leaves off and tree

planting begins, nor dodging studies in utilization to determine what species to favor in natural stands and what species to grow in new forests. Silviculturally and as a watershed protective cover, many species may be the ideal; economically, socially, and utilitarianly, some of them may be nearly valueless. Research in the field of forest resources under Puerto Rican conditions, including methods and the economic and social aspects of logging, conversion, remanufacture and the relative utility of species, must be brought apace with that in forest management if the latter is not eventually to stray.

The Tropical Station knows where it is going in what it has been doing so far. Not a small reason for the progress in 1944 is the fact that part of the research personnel, pending the assignment of the technical ranger, had to help in running the Caribbean Forest. Forest Research was brought face to face with problems of forest management and forest land use and forest utilization as Forest Administration encounters and must meet them. Research got acquainted the hard way, much more thoroughly than through conferences of a Regional Investigations Committee and much more intimately than by look-see inspections with Administration into the problems on this National Forest or that. It could try out, appraise, modify, repeat, perfect, or discard its own research results, if technical practically or practical technicality required.

True, the Caribbean is equal in area to only a good-sized experimental forest of the States yet it must be run as a protection, a production, a recreation forest, to serve the local economy and social welfare, and with an eye to receipts into the Forest Reserve Fund. Progress in forest research and progress in forest administration could, under the Tropical Forestry set up, and have gone hand in hand, and both are better for it. This is an accomplishment for 1944 in addition to the more specific advances and new information outlined by lines of work in the report which follows.

/S/ ARTHUR UPSON
Director

FOREST MANAGEMENT

Greater recognition of the need for utilization studies was one of the clearest results of research during the year, but in the absence of funds, personnel and facilities for such work management research continued as the primary function of the Station.

An overall management research task, long overdue but which had been impossible prior to the establishment of the combined Tropical Forestry Unit, is a comprehensive study of all past investigative work recorded in old files. The closed files of the Caribbean National Forest, although incomplete because of damage due to the 1932 hurricane, yielded much information of value, some of which makes unnecessary studies which had been planned. The files of the Insular Forest Service and of the Extension Forester have not been completely examined as yet. However, they have already yielded a wealth of information regarding past nursery work and the dates and methods of establishment of early plantings which now bear reexamination and measurement. Copies of all material of value are being placed in the research file, and workers on a white-collar relief project (financed from Insular funds) are summarizing and analyzing data which need it.

Another prerequisite to future forest management and research is accurate evaluation of the many tree species, both native and exotic, which confront us. As detailed study of wood properties has not been possible, we are forced to guide ourselves by (1) opinions of woodsmen and woodworkers, (2) observation of tree form and growth, (3) growth measurements in the few instances that are available, and (4) published literature. To the present we have not had ready access to published literature because information relative to tropical trees is widely scattered through a large number of publications. As a part of the white-collar relief project we are making a complete search, book by book, for any mention of native Puerto Rican tree species. Reference lists will be placed on cards indexed by species and kept current as new literature is acquired. The results of this work are not yet available but will soon make possible a rough classification of our species based upon all available published information regarding both silvicultural and utilization factors.

REGENERATION

Studies of seed, nursery, and planting problems were continued with 86 different species, 43 of which were new, and nearly all of which are native. Although the properties of their woods have not been studied in detail, all of these species appear to have a place in management because of (1) rapid growth, (2) large size at maturity together with good form, or (3) aggressiveness on poor sites.

As many of the species studied had not been the subject of previous research and because the potentialities of their woods were not well known, only exploratory investigations were carried out to determine if they could be propagated easily. If difficulties were encountered, further

research was postponed until it is certain that the utility value of the tree justifies additional effort.

Germination, viability and weight of the seeds of 49 species were determined, and the relative effects of sun and half shade upon seedling development in the nursery were studied with 16 species.

The Forest Regeneration Manual referred to in the last report is pending completion of the search in the library for related literature. All of the regeneration studies made during the year have contributed toward its completeness.

Plantation surveys have continued during the year. The survey of the Luquillo Division has been completed and preliminary data have been summarized for the Toro Negro Division.

As in the previous report, the three line projects, seed, nursery, and planting studies, are here discussed together.

Species Experiments

Albizzia, Albizzia procera, reported last year as one of the most promising species yet found for farm plantings has been eliminated from future consideration as a result of the discovery of a disease similar to Dutch elm disease which often kills the trees before they reach 12 inches in diameter,

Granadillo, Buchenavia capitata, a tree which produces wood suitable for construction and furniture, was found last year to be easy to propagate. Studies carried to the field show planting survival to be low unless trees are cut back to 3 inches in height or less at the time of planting.

Ucar, Bucida buceras, one of the most important trees of the dry section because of its excellent construction wood, has not yet been planted on a large scale due to low seed viability. A cutting test of the seed of a large sample showed that 64 per cent of the seeds were woody, that is, without embryo; 13 per cent hollow; 9.5 per cent properly developed, but insect infested; and 3.5 per cent decayed. Thus, only 10 percent were apparently sound on the basis of a cutting test. Actual germination in the nursery is generally not more than 2 per cent. Tests to determine if there was some relationship between the viability of seed of different individual trees were negative. Also seeds of different ages were tried, with negative results. Almost no germination was obtained from any tests made during the past year. Wildings, generally uncommon, were found at one location, lifted, and planted on what appeared to be an optimum site. Failure was complete, probably due to difficulty of lifting wilding stock from shallow rocky soil without excessive root damage. A small amount of stock which had previously been produced was planted, but survival was only 10 per cent on a very good site. Further study is warranted.

María, Calophyllum antillanum, a very aggressive species which produces construction timber, has been direct sown on a large area of

degraded deforested lands. The tree is rather slow growing, but is easily established on difficult sites. In the hope that nursery stock cut back to about 1 inch above the root collar might grow more rapidly during the first three years, trees were planted at two different sites. An experiment with a related species had shown good survival with this method although neither species transplants well if not cut back. Results, although not complete as yet, indicate that no increase in growth may be expected, and therefore direct seeding will be continued.

Spanish cedar, Cedrela odorata, has been almost completely neglected in past plantings. This species, native to the island, produces a very valuable furniture wood. Because it was rare, seed of another species was imported for large scale plantings, nearly 100 per cent of which have failed. With the thought that the native species might be more successful, preliminary regeneration studies were started. It was found that neither the seed nor nursery propagation present difficult problems. Trees produced in direct sunlight are more vigorous than those in partial shade. Small scale plantings in the central mountains and on the northern foothills survived well, but within the first year have taken on an unhealthy appearance. The planting in the mountains is within 50 feet of a natural tree of this same species, and therefore chemical soil factors do not appear to be the cause of its condition. It is true that this planting is on a poorly drained site but the same unhealthy appearance is found on a well-drained site in the foothills. A third planting, under partial shade in an area where drainage is not good, remains healthy. A possible factor responsible for these differences is organic matter content of the soil, which varies greatly in different locations. This problem of cedar-site relationships has been a subject of study in Trinidad for more than 30 years and has not yet been solved. Work will continue on a small scale as seed becomes available.

Uvillo, Coccolobis laurifolia, is one of the more prominent species of the limestone hills in the drier portions of the north coast. It is a vigorous sprouter, is apparently fairly rapid in its growth, and produces a stem much larger than most of the trees in this region. It appears to have a place in conversion from a chaparral type to high forest. Seed studies show germination to be high, nursery propagation to be simple, and planting survival to be fairly high. Wildings are abundant and are proving equal to nursery stock for planting.

Uva de playa, Coccolobis uvifera, is a native of coastal thickets, and although not important from the standpoint of its wood, has great value for sand fixation and camouflage. As a result of a request from the Army for a plant to serve this purpose, studies of its propagation were started. It was previously thought, as a result of studies elsewhere, that the propagation of this species would be difficult. However, at the present time good germination is resulting from a sowing in the nursery. Planting of this stock will be tested.

Capá prieto, Cordia alliodora, a tree which produces an excellent cabinet wood, has generally had low survival in forest plantings. Further study of past planting indicates that this species is very sensitive to planting disturbances and site differences, but may be successfully established

if planting crews are closely supervised and proper stock issued. Numerous satisfactory plantations have been discovered. In an effort to increase survival, attempts were made to improve the quality of nursery stock. There are several indications that this may be the key to the problem. Close spacing in the nursery is very undesirable. Trees should be spaced at least 6 x 6 inches. Drilling is better than broadcasting, as it provides better control of density. Because of unreliability of germination it is thought desirable to sow several seeds in holes spaced 3 x 6 or 6 x 6 in the nursery. These can then be thinned as necessary. Transplanting in the nursery has no marked beneficial effect upon the quality of stock. Stock cut back to 3 inches above the root collar is superior to unpruned stock. Underplanting of wildings made on dry sites has given an early survival of 100 per cent, indicating that this type of stock should be used where available.

Guara, Cupania americana, a good post species on poor sites, was found last year to have seeds of very short viability. Germination was zero under direct sunlight in the nursery, whereas under half shade fair germination was obtained. Planting of this species failed due to the extreme drought.

Tabonuco, Dacryodes excelsa, a tree which produces a large part of the local construction lumber, is not easily regenerated as it does not transplant well. Use of tar-paper pots was tested during the year, and it was found that very high survival can be obtained by carefully underplanting this species.

Eucalyptus, Eucalyptus spp., a group of very rapid growing fuelwood species appear to have a definite place in forestry, particularly on private lands. Seeds of 8 new species were received from Brazil. Two of these have so far proven easily propagated: E. alba and E. resinifera. Damping off attacked stock of some of the other species. All are being planted with the use of tar-paper pots.

Guayacán, Guaiacum officinale, a very slow growing but valuable tree of the drier forests, producing the lignum vitae of commerce, has probably not received sufficient attention in the past. Direct seeding has succeeded in some places. Tests made during the year indicate that the seed is very perishable and should be sowed immediately after collection. Planting of a small amount of nursery stock was a complete failure.

Guaraguao, Guarea trichilioides, is possibly the most commonly used tree for cheap local furniture. The wood is workable and similar in many respects to mahogany. It was already known that the seeds are perishable. Nursery experiments showed that propagation is almost impossible in direct sunlight and should be done under half shade. Nursery propagation may never be necessary, however, as tests during the year at two locations in the mountains involving 40 acres showed that wilding stock can produce a planting survival as high as 90 per cent if under shade.

Jaguilla, Magnolia portoricensis, produces the most valuable wood for furniture in the central mountains. It is understood that it has not been planted because of low seed germination. Part of two seed samples

collected during the year were sent to the Institude of Tropical Agriculture at Mayaguez for close examination. As a result of studies there and here it was found that the germination is not too low for practical purposes provided that the seed is sown promptly. The seed appears to be weak in pushing up through the soil and therefore must be sown in shallow and in sandy soil. Further tests will continue with the stock produced.

Laurel sabino, Magnolia splendens, produces the most valuable wood that is found in any quantity on the island. It cannot at present be reproduced because of low seed viability. Throughout the year attempts were made to procure seed of this species. Only one sample was collected and this has now been sown in the nursery. There are indications that the seed is very perishable, requiring sowing possibly within 24 hours after the fruit begins to open. Moisture is lost very rapidly, as was shown by tests with an analytical balance.

Ausubo, Manilkara nitida, is a slow growing tree but produces a hard, heavy, durable wood. The tree is very tolerant and natural reproduction is abundant in some places. Because ausubo has been culled from large forested areas where it was once an important tree, a program of underplanting may prove desirable in the future. Tests made during the year show that the seed is perishable, remaining viable for not more than one month. Experimental planting shows that this species is sensitive to root disturbance and does not revive for months after bare-root planting. Planting with tar-paper pots has proven successful, even on dry sites.

Chilean mesquite, Neltuma chilensis, is a South American species similar to the mesquite of North America. It produces a good wood for railroad ties, posts, and fuel. With seed procured in South America regeneration experiments were carried out. Neither the seed nor the nursery propagation present serious problems. Survival is high on dry sites, even in dry weather if the trees are cut back to 2 or 3 inches above the root collar. Early growth appears to be more rapid than that of the northern mesquite.

Mesquite, Neltuma juliflora, is a rapid-growing fuelwood and posts species which appears to be much more productive than any of the other short trees generally found in dry forests. It spreads rapidly in pastures where the animals eat its seeds but in forested areas where no grazing is possible underplanting may be the only practical method of conversion. Propagation in the nursery was found to be simple. Plants cut back to 1 inch above the root collar survived very well on dry sites even though they experienced a heavy drought during the first few months. Direct seeding did not prove successful as the young seedlings are very small and easily damaged.

Cojóbana, Piptadenia peregrina, a fuelwood tree in second growth forests, is considered promising for farm forestry as it is suited to poor sites. As previously reported, seed spotting is not successful. A planting made on a dry site just previous to a severe drought gave 36 per cent survival, which is considered high under the circumstances. Growth had been moderately rapid, some of the trees being 5 feet tall after 1 year.

Palma de sombrero, Sabal causiarum provides the raw material for a local hat and broom industry. The construction of military bases has resulted in the destruction of the best stands of this tree so that now its regeneration is very necessary. Studies with the seeds during the year show that germination is often slow without treatment. Soaking in water overnight and placing in the sun during the day for a period of 5 days did not hasten germination. Growth in the nursery is also slow.

Cassia, Sciacassia siamea, has been the subject of much nursery research because of its importance as a rapid growing fuelwood tree for farm forests. In a recent planting experiment it was noticed that much higher survival results if the stock has not been heavily watered during the month previous to lifting. Stock so treated is more woody and more resistant to evaporation. This finding may well be applicable for other species and further investigation will be carried out.

Triplaris, Triplaris americana, a rapid growing exotic of good form, appears to be similar to Eucalyptus in its characteristics. It has proven easy to propagate in the nursery. On humid sites it survives well and resumes growth shortly after planting.

Higuerillo, Vitex divaricata, a tree of the central mountains, is valuable because of its very durable wood. In the nursery, stock should be spaced 6 x 6 inches and requires full sunlight. Stock should be grown 9 to 11 mm. caliper and should be cut back before planting. When underplanted its survival is high, but the young trees soon require liberation from shade.

Plantation Surveys

The analysis of the survey of the Rio Abajo Forest plantations referred to in last year's report was completed, and the results are briefly as follows:

A total of 2,692 acres have been planted at Rio Abajo (2,700,00 trees). Survival has generally been poor because of the use of trees not well adapted to the sites and poor planting supervision which resulted from the use of large crews early in CCC days. Recent replanting of better adapted species with smaller crews has been responsible for all of the good plantations to be seen. The Honduras mahogany plantations in the sinkholes are the best on the island. Half of the area originally planted is still so open that complete replanting is necessary. Fifteen per cent of the remainder is covered but should be replanted with trees better adapted to the site. Of 19 species planted, only 8 are promising, and the future planting of these should be governed strictly by the 5 sites recognized in this forest.

The species recommended for future planting are:

Swietenia macrophylla	Calophyllum calaba
Montezuma speciosissima	Petitia domingensis
Tectona grandis	Casuarina equisetifolia
Eucalyptus robusta	Hyeronima clusioides

A similar survey of the plantations of the Luquillo Unit has just been completed. The most significant results are as follows:

A total of 3,822 acres have been planted in this forest (3,870,000 trees and 38,000 pounds of seed). Planting here, as in Rio Abajo, was not successful at first because of efforts to reproduce climax forest species on barren degraded sites. More area was planted than later proved necessary, as on many brushy areas the native species have since dominated the planted trees and are now superior to them. About 10 per cent of the plantations need replanting to complete the forest cover. Of the balance, one third should be soon replanted to species better adapted to their sites. Of a total of 24 species originally planted only 7 are recommended for the future. One of these is an aggressive tree for reforestation of bare lands. The other 6 are for underplanting in culled over forest. Of these species only 4 need be produced in a nursery, as the balance are direct sown or reproduced with wildings.

The species recommended for future planting are:

Cordia alliodora	Swietenia macrophylla
Guarea trichilioides	Petitia domingensis
Lucuma multiflora	Tabebuia pallida
Ocotea moschata	

Cooperation

Assistant to the Puerto Rico Land Authority in the management of their forest lands was continued during the year. Numerous field trips were made with a representative of that agency to inspect and supervise planting work of lands recently acquired from Central Cambalache. The Land Authority is following closely our recommendations.

Seeds of muñeco, Cordia nitida, rosa imperial, Cochlospermum vitifolium capá prieto, Cordia alliodora, and Guayabeta, Eugenia stahlii, were sent to the Commissioner of Parks in Florida. Seeds of maría, Calophyllum calaba, queen of flowers, Lagerstroemia speciosa, capá prieto, Cordia alliodora, and pine, Casuarina equisetifolia were sent to an individual in St. Thomas.

A trip was made to Mona Island in cooperation with the Insular Forest Service to determine the status of plantations there. It was found that a large area planted to Dominican mahogany was much in need of cleaning and pruning. An experimental sowing of Dominican mahogany was set out under light herbaceous shade.

MENSURATION

More attention was given to mensuration research during 1944 than in previous years. Records of numerous old plantings have been found, and some of these were examined and measured to determine their growth rates.

Mensuration here was advanced by the recent visit of Mr. James W. Girard, who ably appraised our needs in this field and constructed for us,

based on observations and a few measurements, a set of three form class volume tables applicable to all of our hardwoods.

A complete set of converting factors for all forest products was made so that they might be expressed in terms of board feet, and so that prices for the various different products might be better correlated.

Tree Studies

The results from the three sample plots established at El Verde during 1943 are already beginning to appear. At the time of the one-year checkup to determine the condition of the metal tags it was found that the trees have grown considerably, and it was decided to remeasure the two smaller plots. Although further measurements are of course necessary before reliable growth data are accumulated, these first measurements are of interest. Because these plots all have a high basal area for their age, stand growth was not rapid. In one plot the basal area increased 11 per cent during the year, and the total at the end of the year was 96.5 square feet per acre. Growth of individual trees which had sufficient light was rapid. Dominant trees of the better species grew 0.3 to 0.8 inch in diameter in 18 months.

Pino, Casuarina equisetifolia, was found to grow more slowly in the mountains than on sandy soil at sea level. An 8-year-old planting at 1,000 feet elevation averaged 5 inches in diameter.

Cedro, Cedrela mexicana, has generally failed in plantations. Measurements were made, however, in a fairly successful plantation at 1,000 feet above sea level. The trees in this plantation are 10 years old and averaged 4.9 inches in diameter and 22 feet in height. A small number of trees were tagged for future measurement.

Honduras mahogany, Swietenia macrophylla, has not generally done well in the mountains. During the year a 13-year-old planting was found at about 1,000 feet above sea level which is healthy and apparently will grow to maturity. Tree measurements in the plantation showed the average diameter to be 5 inches.

Dominical mahogany, Swietenia mahagoni has been successfully established in the dry forests of the southwest coast. It is reputed to be slower growing than Honduras mahogany, so a small sample plot was permanently tagged. In a plantation 13 years old the trees averaged 3 inches in diameter and 12 to 15 feet in height. This height growth is much less than that of the other mahogany but the sites on which the two species grow are not comparable.

Cedro de India, Cedrela toona, was introduced and planted in the Luquillo mountains 15 years ago. Record was found of the planting, and a number of trees were measured. The average for the small plantation was 6.1 inches in diameter and 15 to 20 feet in height. This plantation was thought particularly worthy of observation as this species looks more healthy than C. mexicana.

A degraded mixed forest has been under measurement for about two

years in order to determine the rate of growth of the more dominant trees. As yet no reliable results of this nature are available, but the stand as a whole is growing much slower than less disturbed forest despite a lower basal area.

Trees of the following species were tagged in natural forests for remeasurement: ucar, Bucida buceras; jaguilla, Magnolia portoricensis; hueso, Mayapea domingensis; mesa, Micropholis chrysophylloides; caoba del país, Podocarpus coriaceus; and almendra, Terminalia catappa.

Stand Studies

Small permanent sample plots were established in a plantation of María, Calophyllum calaba, 20 years old. The total number of trees was 721. In one plot thinning was needed and was done. The average diameter as about 4 inches, and the average height 35 feet. This is considered very good growth on an extremely difficult site.

A 1/10-acre plot of pomarrosa, Eugenia jambosa, was remeasured, and as was expected, its basal area increment was large, having increased from 38 to 54 square feet per acre in 12 months.

Two 1/10-acre permanent plots were established in a 15-year-old plantation of Dominican mahogany, Swietenia mahagoni. This plantation is on a humid site which is apparently not suited to this species. In addition both plots are dense and stagnated. Average diameter is 4.8 inches; average height is 18 feet. Following measurements of growth for a few years it is proposed to thin one or both of these two plots.

SILVICULTURE

Observation throughout the forest had shown previously the great need for improvement and salvage cuttings. Although little is yet known about the silvical characteristics of Puerto Rican tree species it seemed that enough was known to permit cuttings directed primarily toward the removal of misshapen and dying trees and the more obviously inferior species, and the improvement of spacing. The following policy was set up:

1. The establishment and maintenance of a uniformly-spaced stand of the best trees available and which will provide 60 per cent shade on the forest floor is the final goal.

2. Trees will be removed to the degree required for compliance with No. 1 in the following order of priority:

   A. Dead trees
   B. Overmature trees
   C. Mature trees
   D. Immature trees of poor form regardless of species
   E. Immature trees of good form but of inferior species

F. Immature trees, of the better species and of good form, the removal of which will improve spacing and favor the growth and development of neighboring trees of at least equal value.

This policy was taught to the rangers and guards of the Caribbean National Forest and has been put into practice in timber sales. To date about 1,000 acres have been improved by this type of cutting, with receipts of more than $18,000, nearly paying for all protection and management costs of the Forest.

The establishment of natural areas in relatively undisturbed forest is a necessity if the silvical characteristics of individual tree species are to be determined. During the year an area of 35 acres was set aside for this purpose in the Cambalache Experimental Forest and larger suitable areas have been located in the Luquillo Division of the Caribbean and in the Insular Forests of Guánica and Maricao.

Cooperation

Data collected in the San Germán arboretum by L. E. Gregory, a Collaborator of this Station, were compiled and summarized for his use in connection with an ecological study of this area which will be published in The Caribbean Forester.

EXPERIMENTAL FOREST MANAGEMENT

The three experimental areas were used more intensively than ever before in regeneration research, and saleable products were yielded by each of them. Guards were on duty throughout the year at Cambalache and St. Just.

Cambalache

Preliminary work was continued to make this forest a very useful area for research in silviculture, mensuration, and economics. Two relief projects totaling $17,000 were in progress during the year. The boundaries were located, cleared, fenced, and planted with trees to provide permanent fence posts. Approximately two miles of utilization road have been built and a house for the guard is nearly completed.

Twenty seven regeneration experiments were started during the year, 8 of which are now completed. The results of these are reported under "Regeneration" earlier in this report. The value of any existing cover on shallow-soiled rocky slopes has been underestimated in past plantings. In this dry region planting survival is very low unless shade is provided.

Improvement cuttings yielded 570 posts and stakes and 32 cords of wood, sold for $145.09 in 34 different sales. In addition members of 184 different families in the vicinity removed 2,792 bundles of dry fuelwood from the forest floor, or a total of 42 cords.

An annual report complete with recommendations to the Land Authority

for the management of their forest lands was submitted to the Executive Director in July. A copy of this report was sent to the Assistant Chief under the designation RS-TR, COOPERATION, General.

St. Just

The St. Just area continued as the most important experimental forest from the standpoint of number of studies in progress. During the year 53 regeneration studies were conducted in the area, 28 of which were completed. These include all of the more important species with which we are working.

Improvement cutting has been done in parts of the young forest. The work is done by nearby residents under supervision of the guard, and they take the yield in the form of fuelwood. Fifteen families removed 1,011 bundles of such wood, or a total of 8 cords, during the year. In addition 60 sacks of charcoal were made by them and were distributed among the families of the narby resettlement project. Fifty-five fence posts were cut for use on the forest.

This area includes a 17-acre pasture which has been used by families living nearby. The number of stock was reduced to six during the year and an agreement was made with the owners of the animals to imporve the pasture.

A rain gauge was maintained throughout the year. The total precipitation for 1944 was 72.15 inches.

Río Piedras

This Experimental Forest, a 10-acre woodlot within 1/2 mile of the headquarters, is largely forested and was used for underplanting experiments during the past year. In addition 2 small permanent sample plots were remeasured. In all, 865 fence posts, 110 stakes, and 25 hoe handles were removed from parts of this forest.

As it has been impossible to station a guard at this woodlot, trespass has not been entirely prevented. Until such control is assured further studies of the natural development of the canopy must be postponed. On the other hand, the small amount of trespass which takes place does not interfere with studies of underplanting, 10 of which are now in progress in the forest.

OTHER RESEARCH ACTIVITIES

Three fields of forest investigation have such a direct bearing upon forest management that they must be given attention if management research is to be headed toward proper objectives. These three are studies of dendrology, forest utilization, and land use. Accordingly the work of the staff, while directed basically toward the solution of management problems, included small projects within these branches of research.

DENDROLOGICAL STUDIES

The Station has always been forced to devote research time to taxonomy and tree identification because of the large number of little-known tree species in our forests. Correspondence has been active with numerous botanical institutions, notably the New York Botanical Garden, which has probably the most extensive Puerto Rican collection.

Because of confusion in scientific nomenclature which has existed due to the use of different system within the Caribbean area a complete list of native arborescent species with all known synonyms was prepared and sent to the Washington Office for checking. Thanks chiefly to Mr. Dayton the list was subjected to careful study by available taxonomists and has been revised in accordance with the now generally accepted International system of nomenclature. At Mr. Dayton's suggestion this list will not be published until after the war when a closer check can be made by additional taxonomists which will be then available. For the present, however, it serves as a guide in The Caribbean Forester and a few copies are being distributed to workers particularly interested.

Cooperation

Cooperation has been especially active with the New York Botanical Garden during the past year. Samples of leaves, fruits, bark, and wood of 5 species were sent to Dr. Krukoff for study of chemical derivatives. Our complete set of sheets of the family Sapotaceae were sent to Dr. Cronquist for study in connection with his revision of the family. In return the Garden determined 40 specimens from our herbarium.

The herbarium was made available to L. E. Gregory, a Collaborator of the Station working with the Institute of Tropical Agriculture at Mayaguez, Mr. Gregory has started the preparation of an artifical vegetative key to the native arborescent species of the island.

Nursery stock of seven native species was sent for planting in the San Germán Arboretum under an agreement with the Polytechnic Institute.

FOREST UTILIZATION

The need for forest utilization research is obvious at every turn. Decisions as to which tree species have highest priority in management research must now be made without the benefit of reliable data on the

properties and utility values of their respective woods. Requests to us for such information by outsiders often must go unfulfilled. During 1944, as in previous years, when opportunities were presented to make small studies involving little investment but which could help answer some of the more important questions regarding our woods, these opportunities were not lost. An additional job of immediate importance during the year was the determination and approval of the Chief's Office of new minimum stumpage rates for the Caribbean National Forest.

Minimum Stumpage Rates

Concurrent with the discovery for the need of improvement cuttings in the Caribbean National Forest was a critical examination of minimum stumpage rates to determine their relation to the relative desirability of removal, and the relative prices elsewhere, of the various types of material to be sold. Numerous inconsistencies in the rates in use were found and these were removed by standarizing the rate per thousand for all material sold for use in the round. Sawtimber prices were also modified to improve the relation between various species. The new rates thus determined were approved by the Chief's Office and are now in use on the Caribbean Forest. They are subject, however, to further improvement at a later date when more data are available on the differences in intrinsic value of railroad ties or ox yokes, for example, as compared with fence posts of the same wood volume. This same schedule of stumpage rates have been approved by the Commissioner of Agriculture and Commerce for use also on the Insular Forests.

Service Records

A study of fence posts of 11 species in the Toro Negro Division showed that the average run of species last not more than 2 years at this site. Cafeillo, Casearia sylvestris, was the best of the species tried, 83 per cent of the posts being serviceable after 2 years. Others fairly serviceable were guamá, Inga laurina, 59 per cent, and rabo de ratón, Casearia arborea, 55 per cent. Posts of the following species were less than 30 per cent serviceable after 2 years: moral, Cordia sulcata; montequero, Rapanea ferruginea; camasey, Heterotrichum cymosum; laurel geo, Ocotea leucoxylon; cieneguillo, Myrica deflexa; and achictillo, Alchornea latifolia.

Treatment of pino, Casuarina equisetifolia, a common post species, with carbolineum by hot and cold bath has proven practical. After boiling 6 to 9 hours in the solution and cooling, lateral penetration was 3/4 to 2 inches. A set of posts so treated have been placed for study of durability.

Seasoning

Small samples of the four mangrove species previously oven-dried to determine moisture content were placed in an open shed at Río Piedras to take on moisture. It was found that the samples, which were approximately 2 x 2 x 6 inches, reached equilibrium moisture content after 104 days.

The green moisture content of 1 x 1 x 1 inch samples of 4 species were found to be as follows:

Micropholis chrysophylloides	33 per cent
Sloanea berteriana	39 " "
Buchenavia capitata	70 " "
Cyrilla racemiflora	132 " "

The shrinkage of small samples of Cyrilla racemiflora in drying from green (132 per cent moisture) to oven-dry is as follows:

Radial	8.9 per cent
Longitudinal	1.6 " "
Tangential	18.8 " "
Volumetric	27.0 " "

Utilization Studies

Studies of an exploratory nature were initiated towards the close of the year of the present methods of logging, conversion, seasoning, and remanufacture of lumber in Puerto Rico. This project was made possible under a memorandum of understanding with the P. R. Development Company whereby it financed all travel expense and the Washington Office and Forest Products Laboratory paid the salaries of Messrs. James W. Girard and Laurence V. Teesdale, together with contributed time of Messrs. Wadsworth and Upson. The purpose of the cooperation by the P. R. Development Company is, of course, the expansion and stimulation of woodworking plants as one part of its program for industrialization of the Island. Such an industry would for the present draw its major sawn lumber supply from Dominican Republic, Haiti, and perhaps other nearby countries in the Caribbean area.

In this project, about three weeks were spent on the island in a quick survey of its timber esources; in observing the ox and hand logging and handsawing in the woods; in such lumber seasoning as is practiced; and in methods of re-manufacture of round timber, cants, and lumber into and the nature of the various wood products now made on the Island. Messrs. Girard and Teesdale then spent about one week in the Dominican Republic and another in Haiti, primarily to determine the character and sources of lumber which would be available for importation by the P. R. Development Company. Probably two man-months of their time will have to be spent in the preparation of their report and recommendations which is under way at this time.

Without awaiting completion of the report, it is safe to enumerate here some of the more significant findings in these studies.

1. There is not enough sawtimber in Puerto Rico now nor will there be in the next 5 years or so to justify a portable sawmill. Handsawing in the woods must, therefore, be continued. Even if there were timber sufficient in quantity and concentrated in a few locations to justify the smallest type of portable mill there is question, from the employment angle, whether or not one should

be installed. In other words, it is doubtful if a small mill would appreciably reduce the cost of lumber to the fabricator, yet it would take away 75 per cent of the present opportunities for employment in lumber conversion.

2. The annual drain on the forests of Puerto Rico is greater than any of us suspected. From a social standpoint, fuel and charcoal wood are by far the most important products, and their conversion and distribution form stump to home provides an enormous number of man-days of employment yearly. The second product in greatest demand is material of a small number of species which is large enough to be sawed into boards or flitches as narrow as 4 inches wide and as short as 6 feet long for re-manufacture into wood products. In the third group fall round material down to as low as 2 inches in diameter at the small end for a great variety of products, such as 5-foot stakes, fence posts, medium-sized poles, narrow-gage railroad ties, and blanks for other kinds of products.

3. There are more woodworking establishments on the Island than any previous data show. They run from 2-man family affairs making and repairing oxcarts, wheels and tongues, ox yokes, handles, venetian blinds, etc. to a few 50-man plants making furniture, millwork, wood novelties, etc.

4. Whether or not this larger-than-thought drain on the forests exceeds sustained yield cannot be determined until better data are available on present growing stock and rate of growth.

5. Finally, the report will or should bring out the urgent need for a small allotment of funds to finance a continuing project in this field. This need is mentioned in the foreword of this report. It would include the applicable phases of both forest resource investiations and the proposed forest utilization units. An allotment of $6,000 to $8,000, depending on the grade of the technician assigned plus one clerical man-year would be sufficient. Funds so earmarked are more important than an increase in the forest management research allotment or the initiation of forest influences work.

Other Cooperation

Samples of lumber were provided the Puerto Rico Development Company for research purposes. Samples of lumber, palm, and vines were furnished to the owner of a furniture shop in an effort to develop new uses. A sample of the wood of torchwood, Amyris elemifera, was sent to the Mahogany Association.

LAND USE STUDIES

One of the most pressing immediate problems in the management of the public forests of Puerto Rico has resulted from the cultivation of non-agricultural lands. Because of the pressure for land, people were living on many tracts of non-agricultural land at the time of their acquisition for

public forests. These people are all farmers and their removal has been difficult, mainly because of the scarcity of farm land elsewhere. As a consequence soil deterioration is excessive in some parts of the forest.

In an effort to alleviate the problem by stopping cultivation of the worst areas, a survey was made with the ranger of all of the lands in farm use on the Toro Negro Division. The areas suited to continued cultivation were located and new farm units were laid out each including an adequate area for 1 family. There are only 44 such units, but 123 families live within the Division. New permits were drawn up which better control agricultural practices. The ranger is gradually vacting the least desirable areas, and to date has located 50 families on lands outside the Forest.

INSULAR ACTIVITES INVOLVING RESEARCH

The joint direction of Federal and Insular Forest activities in Puerto Rico made it possible to obtain application in the protection and management of the Insular forests of most of the results of research by the Tropical Station. Among these were nursery and planting technique, stand improvement methods to the extent timber is being cut on the Insular forests outside of mangrove areas, and the adoption of uniform schedules of minimum stumpage and special use rates which were a product of research.

Two pieces of proposed Insular legislation were prepared late in 1944; one of direct concern to research and the other related to overall forestry on the Island. The first was the redrafting of the Insular Forest Research bill drawn up last year but which, like all other legislative matters, was not acted upon by the Insular Legislature; and its submission to and approval by the Commissioner, Auditor, and Attorney General of Puerto Rico. There is expectation that it will receive the approval of the Governor and the Legislature. This proposed bill would authorize an annual expenditure of $30,000 for forest research and would appropriate that sum for the coming fiscal year. It directs that the Commissioner of Agriculture and Commerce enter into a cooperative agreement with the Secretary of Agriculture whereunder this appropriation would be deposited in the Cooperative Work Fund of the Federal Forest Service which would in turn perform the research. The preamble of the bill is indicative of its scope, as follows:

> To provide through investigations, experiments, and demonstrations for the development of scientific forestry information necessary to enable farmers of Puerto Rico to utilize their non-food producing lands for the successful growing of their own wood for fuel, posts, and other farm uses; to stimulate the establishment of stable markets for surplus wood products grown on farms as well as for forest products grown on other lands which farmers can buy, log, process and sell; to authorize the Commissioner of Agriculture and Commerce to enter into a mutually satisfactory cooperative agreement with the Secretary of Agriculture of the United States to carry out the purposes of this Act; to authorize an annual appropriation of and to appropriate for the fiscal year ending June 30, 1946, the sum of thirty thousand dollars (30,000) to be paid quarterly in advance to the Treasurer of the United States pursuant to said Cooperative Agreement; and for other purposes.

The second piece of proposed legislation is now under consideration by the Commissioner and is known as the Watershed Forests Protection Act. Through subsidy and otherwise it would attempt to raise the economic level of the coffee industry, thereby arresting the present clearing of coffee groves and encouraging the establishment of new groves. It would also assist private owners in maintaining and managing existing timber and woodlands, and foster increased planting of timber trees on private land. The preamble of this Bill reads:

> To provide for the control of soil erosion, the alleviation of floods, the protection of watersheds, and the reduction in the rate of silting of reservoirs for power, irrigation and domestic water supplies by and through the rehabilitation and extension of coffee plantations, the planting and care of timber forests and woodlands, and the maintenance and improvement of existent forest cover on steep forest lands; to authorize and appropriate annually the funds necessary to carry out the pruposes of this Act; and for other purposes.

This proposed legislation has many more hurdles to cross than the Forest Research Bill.

LATIN AMERICAN COOPERATION

They year 1944 marked a real advance in closer cooperation between the Station and foresters in other Latin American countries. The Land Tenure meeting of the Anglo-American Caribbean Commission held in Puerto Rico in August brought many scientists interested in forestry to the island including representatives of the Forest Department of Trinidad and British Guiana. Mr. John Beard, Assistant Conservator for the Windward and Leeward Islands, also visited the Station.

One timber resource project, the Chilean mission, continued through most of the year, under the technical direction of the Assistant Chief, Research. Contacts by Station correspondence throughout Latin America were increased.

The Caribbean Forester

For issues of the Caribbean Forester were published. Of a total of 248 pages 120 were in English, 94 in Spanish, and 34 in French. The 21 articles published concerned or were contributed from the following countries: Puerto Rico (5), Columbia (3), Trinidad (2), Mexico (2), Martinique (2), Ecuador (3), St. Thomas (1), Jamaica (1), Cuba (1), Barbados (1), and British Honduras (1). Four articles were by members of the staff.

Volume 6, Number 1 was enlarged to 84 pages (from 50) and full translations of all English articles were made in Spanish and vice versa. French summaries were also included.

The mailing list was circularized in accordance with Regulation 5 of the Office of War Information. As a result 268 names were eliminated. New requests totaled 93 during the year, making the size of the mailing list at the end of the year 471 names.

Timber Resources Project

The Station staff completed a difficult task in the organization of the notes from the survey of the forest resources of Ecuador. The preparation of the report, which contained some 140 pages, required about two man-months.

The only connection with the Chilean Forest Mission being administrative, the results of the excellent job done by the Forest Service party cannot be given in detail here.

Anglo-American Caribbean Commission Activites

Members of the Anglo-American Caribbean Commission, with the top men from its Agricultural Research Council, held two meetings during the year, one in Barbados in March, the proceedings of which are in print, and the other in St. Thomas in September, the report of which has not yet appeared. Among the activities of the Commission and its Agricultural Research Council were several of interest to forestry.

A meeting of the Land Tenure Committee was held in Mayaguez, Puerto Rico in August. It was attended by representatives of the land managing and using agencies in practically every country on the Caribbean. A brief report on it to the Assistant Chief was made under date of October 18, 1944 - R-COOPERATION, Anglo-American Caribbean Commission, Land Tenure Conference.

Immediately following that conference, the Agricultural Research Council, of which Upson is a member, met to make general plans for the coming year and to appoint the chairmen of the various committees. Among the appointments was Upson for the Forestry Sub-Committee.

Before leaving Puerto Rico, R. L. Brooks of Trinidad and D. B. Fanshawe of British Guiana met with Messrs. Wadsworth, Marrero and Upson, informally, to discuss the present status and future needs of forest research that would have application throughout the Caribbean area, including also the long standing proposal to establish a Forest Research Center at the Tropical Station. Report on those discussions was sent the Assistant Chief under date of October 25- R-COOPERATION, Anglo American Caribbean Commission, Land Tenure Conference, (which should have been Forestry Sub-committee).

Towards the close of the year a suggested draft of an agenda for a meeting of the Forestry Sub-committee in 1945 was drawn up and copy sent Brooks, Fanshawe, and the Assistant Chief for comment.

Forest Research Center

Besides furthering the plans for the establishment of a Forest Research Center at the Tropical Station, the Memorandum of Understanding which has been in process of negotiation for a year and a half was finally consummated with the Comptroller for Development and Welfare in the British West Indies. The contributions made by the several colonies in 1943 and 1944 totalling $1,161.46, which had been held in the Special Deposits Account of the Tropical Forestry Unit, were at the end of the year in process of transfer to the Cooperative Work Fund. While this memorandum is broad enough in language to cover the prosecution of research at the Tropical Station in behalf and at the expense of the British Colonies, the plan agreed upon for the present is to use the token contributions in enlarging and increasing the circulation of The Caribbean Forester. This will be put into effect with the April 1945 issue.

Other Cooperation

Progress on the Spanish-English Glossary of forestry terminology has continued. This is a long job, however, and will require much more library research at the University of Puerto Rico before the preliminary stage has been completed.

Volume 3 of Arboles de Puerto Rico and the Introduction to Forestry, both of which are chiefly for Latin America, were not completed because of pressure of other work. The drawings for Volume 3 are ready and Mr. Holdridge has sent us a few of the descriptions to accompany them.

Seed samples were sent as a result of requests from Perú, St. Lucia, and Mexico.

FOREST RESEARCH PROPOSED FOR 1945

FOREST MANAGEMENT

The majority of research in 1945 must, of course, be confined to forest management and the Station's program in that field will be broken down about as follows:

Regeneration

The greater emphasis will continue to be placed during the coming year upon studies of regeneration. There still remain a large number of native tree species which deserve attention, and a few promising exotics will be tried experimentally. Native species will be given priority over exotics because of the certainty of their adaptability. An effort will be made to add as much new information as is possible to our present knowledge of seed weights, extraction methods, pretreatment, germination, storage and nursery propagation, including use of water and shade, transplanting, lifting, pruning, best stock size and effects of sun and shade.

Mensuration

Knowledge of mensuration will be advanced materially by the proposed measurements of a large number of old plantings, records of which are now being located and summarized for this purpose. It is believed that this project will furnish much on tree growth and at a minimum of cost. A few small permanent sample plots may be established.

Silviculture

With silvicultural work in the form of improvement cuttings progressing on an unprecedented scale on the Caribbean National Forest, much new information should be available through general observations, such as the effects of different degrees of opening upon vine and weed growth and rapidity of canopy closure following cutting. Information of this type will have an immediate value in marking practice for improvement cuttings. Except for studies in permanent sample plots no intensive silvicultural research will be done, as this requires the establishment of large plots in mixed forests and thus is more than the Station can handle at present. Also, the need is not as pressing as for some other projects, because there is a large area of forest which can and should be improved by "common sense" methods (i.e. elimination of overmature, crooked and inferior trees and improvement of spacing) before intensive stand betterment begins. Comprehensive silvicultural research involving large plots will have very high priority after the war.

It is expected that the three experimental forests will be of more service during the coming year than ever before. At Cambalache vine cutting is being started by a relief crew in the demonstration area as a preliminary to profitable management, a series of permanent sample plots will be established in a natural area in this forest. At St. Just a continuation of planting research on about the same scale is planned, with small-scale experiments on the effects of modification of the canopy in young wild

forest. Underplanting studies will be carried out on a larger scale in the Rio Piedras woodlot.

Collection of herbarium specimens will continue as in the past, as an activity incidental to other field work. All old material will be mounted and an effort will be made to have specimens as yet unidentified determined by the New York Botanical Garden.

OTHER RESEARCH ACTIVITIES

The entire time of the research staff can not be devoted strictly to forest management research projects. Up to as much as 20 per cent will have to be spent on work incidental thereto, in other research fields, and in service to Administration. Wadsworth, however, will drop his present P & M work on the Caribbean when the new District Ranger is assigned July 1 or thereabouts.

Utilization Studies

Limited utilization studies will continue to receive attention because of their importance to a proper orientation of forest management research. For example, equilibrium and green moisture contents and specific gravity of the more common woods will be determined; posts of several species now considered virtually worthless will be subjected to simple preservative tests; and other simple studies made as needed.

Utilization studies of a still broader character, however, should be financed promptly. They would represent a continuation and intensification of the work started by Messrs. Girard and Teesdale. They would fall mostly in the redefined financial project of Forest Resources Investigations but they should also partake of the character of work apparently proposed for the forest utilization units. At the risk of undue repetition in this report, may it be said that investigations of this character cannot longer be delayed.

Insular Forest Research

The proposed Forest Research Act of Puerto Rico, if it is approved by the coming Legislature which must close its session by April 15, will demand considerable time of the staff in preparing a program for the fiscal year 1946 which is mutually agreeable to the Commissioner of Agriculture and Commerce and the Secretary of Agriculture; in recruiting the necessary personnel; and in getting the work under way. It is possible that some but not all of the proposed new utilization work outlined in the preceding paragraph can be handled from the cooperative work funds which this Research Act would provide.

Latin-American Cooperation

The first job here is increasing the size and distribution of The Caribbean Forester mostly but not wholly, from the cooperative funds contributed by the B.W.I. Colonies.

Other jobs and impending developments in the field of Latin-American cooperation must be definitely provided for, namely: Wadsworth's trip to Dominican Republic, Haiti, Cuba, and Jamaica in February or March; preparation for and holding the first meeting of the Forestry Sub-committee of the Agricultural Research Council, Anglo-American Caribbean Commission, probably in Trinidad; and the probable attendance of the Director at the Third Inter-American Conference on Agriculture in Venezuela. May 1945 has been suggested in a preliminary way for the meeting of the Forestry Sub-committee, but if the Inter-American Conference will include attendance from the Tropical Forestry Unit, as now planned, the forestry meeting should be delayed so that both can be accommodated in one South American trip for both Wadsworth and the Director.

Joint Research-Administration Jobs

Several jobs jointly research and administration will have to be given attention by the research staff, such as land-use studies in connection with the parcelero system, revision of the project work inventory involving technical forest operations, post-war research planning, timber stand improvement training of guards, etc.

PUBLICATIONS

Marrero, José

Utilización de la caña guadua en Ecuador.
Caribbean Forester, Vol. 5 (3) 145-151, April 1944

Wadsworth, Frank H.

The Development of a maría plantation on a poor site.
Caribbean Forester, Vol. 5 (4) 207-211, July 1944

———————

The First Year in the Cambalache Experimental Forest.
Caribbean Forester, Vol. 6 (1) 34-38, October 1944

——————— and Juan B. Gaztambide

Forestry in the Coffee Region of Puerto Rico.
Caribbean Forester, Vol. 6 (1) 71-75, October 1944

Four press releases and one radio address were prepared to assist the Extension Service in its farm forestry program. A talk on farm forestry in the coffee region was presented by Wadsworth to 20 agents of the Extension Service.

PERSONNEL OF TROPICAL FORESTRY UNIT AS OF JANUARY 1, 1945

(Under Appointment)

Regular Staff

Unit

Arthur T. Upson	Director of Tropical Forestry (Also General Supt. of Forests of P.R.)
Ralph A. Shull	Administrative Asst. and Fiscal Agent CAF-9
Angel Luis Ferrer	Clerk CAF-6
Víctor M. de la Torre	Property and Supply Clerk CAF-4
Ana T. Vega de Jiménez	Clerk-Stenographer CAF-4
María Belén Capiel	Clerk-Stenographer CAF-3
Juan Pérez Meléndez	Automobile Mechanic
Ramón Olivera Barreto	Unskilled Laborer
Alejandro López Ortiz	Unskilled Laborer

Research

Frank H. Wadsworth	Forester P-3, Acting in Charge of Research
José Marrero	Forester P-2, First Technical Asst. in Research
Carmen Garcia Piquera Ruiz	Agricultural Aide SP-4
Luz Silva	Clerk-Stenographer CAF-2
Ernesto Goytía Olmedo	Squad Foreman of Laborers CPC-3

Administration

Emilio Solís	Forest Ranger SP-6
José F. Reyes Mateo	Forest Guard SP-4
Luis Carrión Mercado	Forest Guard SP-4
Raúl Ybarra Coronado	Forest Guard SP-4

Collaborators Without Compensation

Leslie R. Holdridge	Research
Luis Enrique Gregory	Research
Luis F. Martorell	Research
Philip S. Allen	Radio